Topic Brief: ECG in Acute Chest Pain

Date: 12/11/2019
Nomination Number: 0887

Purpose: This document summarizes the information addressing a nomination submitted on October 17, 2019 through the Effective Health Care Website. This information was used to inform the Evidence-based Practice Center (EPC) Program's decision about whether to produce an evidence report on the topic, and if so, what type of evidence report would be most suitable.

Issue: Acute nontraumatic chest pain is the second most common presenting complaint in emergency departments in the United States. Accurate identification of patients with acute coronary syndrome (ACS) is critical for timely intervention and relies largely on proper interpretation of electrocardiogram (ECG) findings. Detecting ECG changes consistent with ACS in the presence of pre-existing electrocardiographic abnormalities and equivocal admission ECG findings is difficult and may be aided by a comparison baseline ECG. Improved accuracy of ruling out ACS, particularly among low risk patients, may help prevent unnecessary hospitalizations and invasive interventions.

Program Decision: The EPC Program will not develop a new evidence product because we did not find enough primary studies addressing the concerns of this nomination (feasibility criterion).

Key Findings

- We did not identify any systematic reviews or primary studies published within the past 5 years that would address the benefits and harms of using a comparator baseline ECG in the diagnostic workup of acute chest pain.
- The current guidelines for the management of acute chest pain do not specifically address the use of available baseline comparator ECGs and instead recommend further assessment using risk stratification tools and additional testing.

- Given the interest that the emergency medicine community has in this topic, it may merit a review of relevant literature to develop a critical synopsis of the available evidence. This critical synopsis would focus on elucidating the specific clinical scenarios where the use of baseline comparator ECGs in the workup of acute chest pain may be applicable in improving the recognition of acute MI and decreasing unnecessary use of invasive procedures and indicate an agenda for future research.

Background

Nearly seven million Americans visit emergency departments (ED) every year with a chief complaint of acute chest pain[1]. The goal of the initial evaluation is to risk-stratify patients based

on the likelihood of ACS and major adverse cardiac complications to determine the need for hospitalization and urgent intervention. ACS refers to a spectrum of clinical presentations concerning acute myocardial infarction (MI), the term used to describe a cardiac muscle injury, detected by a combination of abnormal cardiac biomarkers and at least one other finding consistent with MI[2].

An ECG is pivotal in the decision pathway for evaluation and management of patients with possible ACS. The 2013 and 2014 joint guidelines by the American Heart Association (AHA) and the American College of Cardiology (ACC) for the management of patients with ACS[3, 4] require that an ECG be performed within 10 minutes of arrival at an emergency facility.

An appropriate identification of findings of ACS in acute chest pain patients can be challenging. Numerous studies show that up to 6% of patients with ACS have unremarkable admission ECGs. Furthermore, among acute chest pain patients with admission ECG findings that suggest an acute MI, only 15-25% have a true diagnosis of MI[5]. The remainder have other causes of ECG abnormalities that, although they appear similar to acute MI, are not associated with cardiac muscle damage and therefore are not life-threatening. The most common such causes include left ventricular hypertrophy, left bundle branch block and benign early repolarization, all of which refer to pre-existing ECG patterns that make identification of acute changes difficult. Several approaches exist to assist in accurate interpretation of ECGs in the presence of pre-existing abnormalities, one of which is to compare admission ECGs with a preadmission baseline tracing.

A limited number of historic studies[6-8] suggest that the availability of a comparison baseline ECG may improve diagnostic accuracy and triage decisions in acute chest pain patients and reduce unnecessary admissions and invasive interventions, particularly among those at low risk for an MI. While the availability of baseline ECGs may be valuable, unfortunately it is not always practicable due to a lack of integration between different electronic health records systems. As such, neither the 2013/2014 ACC/AHA ACS treatment guidelines[3, 4] nor the 2018 American College of Emergency Physicians guideline[9] on the management of acute chest pain in the emergency care settings call for the use of baseline comparator ECGs.

Nomination Summary

The goal of this nomination was to evaluate the available evidence regarding benefits and harms of using a comparator baseline ECG in the assessment of emergency department patients with acute chest pain.

Scope

1. What are the benefits of using a comparator baseline ECG in the diagnostic workup of emergency department patients with acute chest pain?

2. What are the harms of using a comparator baseline ECG in the diagnostic workup of emergency department patients with acute chest pain?

Table 1. Questions and PICOS (population, intervention, comparator, outcome, and setting)

Questions	1. What are the benefits of using a comparator baseline ECG in the diagnostic workup of acute chest pain?	2. What are the harms of using a comparator baseline ECG in the diagnostic workup of acute chest pain?
Population	Adults, 18+ years, presenting with acute nontraumatic chest pain	Adults, 18+ years, presenting with acute nontraumatic chest pain
Interventions	The use of a comparator baseline ECG in diagnostic workup of acute chest pain	The use of a comparator baseline ECG in diagnostic workup of acute chest pain
Comparators	Diagnostic workup of acute chest pain without using a comparator baseline ECG	Diagnostic workup of acute chest pain without using a comparator baseline ECG
Outcomes	• Diagnosis of acute MI • Treatment of acute MI • Mortality	• Misdiagnosis of acute MI • Hospital admission • Coronary Care Unit (CCU) admission • ED Observation Unit admission • Coronary artery revascularization • Overall healthcare utilization
Setting	Emergency Department	Emergency Department

Assessment Methods
See Appendix A.

Summary of Literature Findings
We did not identify any systematic reviews or primary studies addressing the subject of this nomination. See Appendix B for detailed assessments of all EPC selection criteria.

Summary of Selection Criteria Assessment and Recommendations
We did not identify any systematic reviews or primary studies addressing this nomination. Please see Appendix B for detailed assessments of individual EPC Program selection criteria. However, considering the interest in this topic from the emergency medicine community, a critical synopsis of the research literature exploring this subject may be merited to further elucidate under what circumstances the use of baseline comparator ECGs in the workup of acute chest pain is applicable and inform an agenda for further research.

Related Resources
While we did not identify any recent studies of the usefulness of a comparator baseline ECG in the emergency department workup of patients with acute chest pain, we found three retrospective chart reviews[6-8] published between 1980 and 1991 that addressed this question.

One study[6] was a retrospective chart review of 236 patients without known history of heart disease presenting to the ED with acute chest pain. The study assessed whether the availability of a baseline ECG improved risk stratification and triage decisions and found that a baseline ECG made no difference among patients who presented with sufficiently diagnostic clinical or ECG findings, but that having a baseline ECG might have helped to avoid unnecessary hospitalizations among patients with equivocal clinical or ECG findings.

The second[7] was a much larger prospective cohort study that compared health records of 5,673 patients with a known history of heart disease who presented to the emergency departments of seven different hospitals with acute chest pain. Contrary to the earlier study, Lee et al[7] found that the availability of a comparator baseline ECG had the most impact among patients with

admission ECG findings of a possible acute MI. Specifically, when a prior ECG was available for comparison, patients without MI who nevertheless had equivocal ECG findings were two times less likely (27% vs. 39%) to be hospitalized and 1.5 times less likely (12% vs. 26%) to be admitted to the CCU. The study found no difference in either hospital or CCU admissions among patients without findings of a possible acute MI on admission ECGs.

The third study[8] was a retrospective chart review of 258 patients admitted to the hospital for suspected acute MI that compared their admission ECGs with the most recent available ECGs recorded before admission to determine whether changes from baseline to admission ECG could help identify patients with a higher chance of having an acute MI. The study found that patients who had admission ECG findings of a possible acute MI and a change from a baseline ECG were at a higher risk of having an acute MI, inpatient complications, and a need for treatment interventions compared to patients without changes from baseline ECGs. The study also found that patients without admission ECG findings of a possible acute MI who nevertheless had a change from a baseline ECG were found to be at a higher risk for requiring interventions.

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Appendix A: Methods

We assessed nomination for priority for a systematic review or other AHRQ Effective Health Care report with a hierarchical process using established selection criteria. Assessment of each criteria determined the need to evaluate the next one. See Appendix B for detailed description of the criteria.

Appropriateness and Importance

We assessed the nomination for appropriateness and importance.

Desirability of New Review/Absence of Duplication

We searched for high-quality, completed or in-process evidence reviews published in the last three years on December 2, 2019 on the questions of the nomination from these sources:

- AHRQ: Evidence reports and technology assessments
  - AHRQ Evidence Reports https://www.ahrq.gov/research/findings/evidence-based-reports/index.html
  - EHC Program https://effectivehealthcare.ahrq.gov/
  - US Preventive Services Task Force https://www.uspreventiveservicestaskforce.org/
  - AHRQ Technology Assessment Program https://www.ahrq.gov/research/findings/ta/index.html
- US Department of Veterans Affairs Products publications
  - Evidence Synthesis Program https://www.hsrd.research.va.gov/publications/esp/
  - VA/Department of Defense Evidence-Based Clinical Practice Guideline Program https://www.healthquality.va.gov/
- Cochrane Systematic Reviews https://www.cochranelibrary.com/
- University of York Centre for Reviews and Dissemination database https://www.crd.york.ac.uk/CRDWeb/
- PROSPERO Database (international prospective register of systematic reviews and protocols) http://www.crd.york.ac.uk/prospero/
- PubMed https://www.ncbi.nlm.nih.gov/pubmed/
- Campbell Collaboration http://www.campbellcollaboration.org/
- McMaster Health System Evidence https://www.healthsystemsevidence.org/
- UBC Centre for Health Services and Policy Research http://chspr.ubc.ca/
- Joanna Briggs Institute http://joannabriggs.org/
- WHO Health Evidence Network http://www.euro.who.int/en/data-and-evidence/evidence-informed-policy-making/health-evidence-network-hen

Impact of a New Evidence Review

The impact of a new evidence review was qualitatively assessed by analyzing the current standard of care, the existence of potential knowledge gaps, and practice variation. We considered whether it was possible for this review to influence the current state of practice through various dissemination pathways (practice recommendation, clinical guidelines, etc.).

Feasibility of New Evidence Review

We conducted a literature search in MEDLINE from December 2, 2014 to December 2, 2019 on the nomination questions No. 1 and No. 2. We identified total of 176 primary studies (including 49 randomized controlled trials and 127 observational studies) and reviewed all study abstracts for inclusion and classified them by question and study designed to estimate the size and scope of a potential evidence review.

Feasibility Key Questions 1&2	
Date searched: December 2, 2019	
Concept	
Previous ECG/EKG available	((baseline or before or current or elective or electronic or EHR or existing or exists or "health record" or "health records" or historical or index or old or on-file or online or past or preexisting or pre-existing or previous or previously or prior or reference) adj5 (ECG* or EKG* or electrocardiogra* or electro-cardiogra* or tracing or tracings)).ti,ab,kf. (7290)
AND	
Emergency Department	Emergency Medicine/ or Emergency Service, Hospital/ or Coronary Care Units/ or Triage/ (86870) OR ("accident and emergency" or "coronary care unit" or "coronary care units" or admission or admissions or admitted or (emergency adj2 (department or departments or room or rooms or unit or units or ward or wards)) or triage or triaged or triaging).ti,ab,kf. (444020)
Limits:	Filters: published in the last 5 years, Humans, English.
RCT N=49	Controlled Clinical Trials as Topic/ or Randomized Controlled Trials as Topic/ or Pragmatic Clinical Trials as Topic/ or Comparative Study/ or Prospective Studies/ (2377907) OR ("randomized controlled trial" or "controlled clinical trial" or "clinical trial").pt. (821971) OR ((clin* adj5 trial*) or control or controlled or random*).ti,ab. (3823368)
Observational/Other N=127	Total minus trials

Appendix B. Selection Criteria Assessment

Selection Criteria	Assessment
1. Appropriateness	
1a. Does the nomination represent a health care drug, intervention, device, technology, or health care system/setting available (or soon to be available) in the U.S.?	Yes.
1b. Is the nomination a request for an evidence report?	Yes.
1c. Is the focus on effectiveness or comparative effectiveness?	Yes.
1d. Is the nomination focus supported by a logic model or biologic plausibility? Is it consistent or coherent with what is known about the topic?	Yes.
2. Importance	
2a. Represents a significant disease burden; large proportion of the population	Cardiovascular disease remains the leading cause of death in the United States, responsible for 840,768 deaths in 2016, including 31.8% from coronary heart disease[1].
2b. Is of high public interest; affects health care decision making, outcomes, or costs for a large proportion of the US population or for a vulnerable population	Yes.
2c. Incorporates issues around both clinical benefits and potential clinical harms	Yes.
2d. Represents high costs due to common use, high unit costs, or high associated costs to consumers, to patients, to health care systems, or to payers	Yes. In 2014 – 2015, the total healthcare expenditures associated with cardiovascular disease cost the U.S. economy an estimated $351.2 billion dollars[1].
3. Desirability of a New Evidence Review/Absence of Duplication	
3. A recent high-quality systematic review or other evidence review is not available on this topic	Yes. We did not identify any qualifying systematic reviews.
4. Impact of a New Evidence Review	
4a. Is the standard of care unclear (guidelines not available or guidelines inconsistent, indicating an information gap that may be addressed by a new evidence review)?	Yes. The standard of care for the management of acute chest pain is defined by several guidelines, including the 2013 and 2014 AHA/ACC guidelines for the management of patients with ST-Elevation and Non-ST-Elevation ACS and the 2018 American College of Emergency Physicians guideline for the management of emergency department patients with suspected Non-ST-Elevation ACS. However, none of these guidelines address the question of whether the availability of a comparator baseline ECG helps improve diagnostic accuracy of an acute MI in the emergency care setting and/or to reduce unnecessary hospitalizations and invasive interventions.
4b. Is there practice variation (guideline inconsistent with current practice, indicating a potential implementation gap and not best addressed by a new evidence review)?	Yes. While the management of ACS largely conforms to the existing guidelines, currently there is no consensus as to whether the availability of a comparator baseline ECG in the workup of emergency department patients with acute chest pain improves recognition of an acute MI and/or helps reduce unnecessary hospitalizations.

Selection Criteria	Assessment
5. Primary Research	
5. Effectively utilizes existing research and knowledge by considering: - Adequacy (type and volume) of research for conducting a systematic review - Newly available evidence (particularly for updates or new technologies)	We did not identify any primary studies published within the past 5 years that addressed the nomination questions.

Abbreviations: AHRQ=Agency for Healthcare Research and Quality; AHA=American Heart Association; ACC=American College of Cardiology; ECG=electrocardiogram